

**What is claimed is:**

- 1) **A thermal protection system comprising:**
  - A) **a carbonaceous core having a first and a second surface;**
  - B) **a layer of aluminum or an alloy of aluminum coated upon said**  
5 **at least said first surface;**
  - C) **a structural portion coated over said layer of aluminum or an**  
**aluminum alloy comprising at least one pair of alternating**  
**layers of:**
    - i) **an aluminum brazing alloy; and**
    - ii) **an aluminum metal matrix composite.**
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2) **The thermal protection system of claim 1 wherein said layer of**  
**aluminum or an aluminum alloy is coated upon said first surface.**
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3) **The thermal protection system of claim 2 wherein said carbonaceous**  
**core comprises a semi-crystalline, largely isotropic, porous coal-based**  
**product produced from particulate coal exhibiting a free swell index**  
**of between about 3.5 and about 5.0 and of a small diameter, having a**  
**density of between about 0.1 and about 0.8 g/cm<sup>3</sup> and a thermal**  
20 **conductivity below about 1 W/m/°K.**
- 4) **The thermal protection system of claim 3 wherein said coal exhibits a**  
**free swell index of between about 3.75 and about 4.5.**

- 4) The thermal protection system of claim 2 wherein said carbonaceous core has a compressive strength below about 6000 psi.
  - 5) The thermal protection system of claim 2 wherein said carbonaceous core has been carbonized.
  - 6) The thermal protection system of claim 2 wherein said carbonaceous core has been graphitized.
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- 7) The thermal protection system of claim 2 further including a protective anti oxidant layer coated on said second surface.
  - 8) The thermal protection system of claim 7 wherein said protective antioxidant layer comprises a member selected from the group consisting of metallic layers, and glass forming metal-halide, carbide or nitride compounds.
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- 9) The thermal protection system of claim 7 wherein said protective antioxidant layer comprises a member selected from the group consisting of ZrB<sub>2</sub>, SiC, and B<sub>4</sub>C.
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- 10) The thermal protection system of claim 7 wherein said carbonaceous core comprises a semi-crystalline, largely isotropic, porous coal-based product produced from particulate coal exhibiting a free swell index of between about 3.5 and about 5.0 and of a small diameter, having a density of between about 0.1 and about 0.8 g/cm<sub>3</sub> and a thermal conductivity below about 1 W/m/<sup>o</sup>K.
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- 9) The thermal protection system of claim 10 wherein said coal exhibits a free swell index of between about 3.75 and about 4.5.
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- 10) The thermal protection system of claim 7 wherein said carbonaceous core has a compressive strength below about 6000 psi.
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- 11) The thermal protection system of claim 7 wherein said carbonaceous core has been carbonized.
- 12) The thermal protection system of claim 7 wherein said carbonaceous core has been graphitized.
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- 13) The thermal protection system of claim 2 further including an anti oxidant blended into said carbonaceous core.

**14) The thermal protection system of claim 13 wherein said anti oxidant comprises a member selected from the group consisting of glass forming metal-halide, carbide or nitride compounds.**

**5 15) The thermal protection system of claim 14 wherein said protective antioxidant layer comprises a member selected from the group consisting of ZrB<sub>2</sub>, SiC, and B<sub>4</sub>C.**